5. ECOLOGICAL CHARACTERIZATION OF THE DISTRICT OF COLUMBIA

This section describes the ecological resources of the District of Columbia, including its plants, animals, and their habitats. The impact of human activities on the District's ecosystem is presented, along with the extent and current status of aquatic, wetland, and terrestrial resources.

5.1 HISTORICAL CHANGE IN THE DISTRICT OF COLUMBIA ECOSYSTEM

Prior to European settlement, the area that later became the District of Columbia was an important village trading center of the semi-agricultural Nacotchtank Indians (Hutchinson, 1977). These Native Americans came in great numbers each year to the region they called their "fishing ground" (Smith, 1972). Following 1630, this largely forested region was progressively cleared for agriculture by European colonists. By the Civil War, most of the Anacostia River basin was under cultivation with tobacco the dominant crop (Williams, 1942). In 1790, the city of Bladensburg was a deepwater port, receiving ocean-going vessels. By 1853, the U.S. Army Corps of Engineers (USACE) had closed the port due to sediment clogging the river channel (Hutchinson, 1977). During the late 1800s, the Anacostia became increasingly sediment-laden; in 1902, the USACE received funding to dredge portions of the tidal Anacostia to provide a shipping channel and "reclaim" mudflats.

Urban development has gradually transformed the land use of the District of Columbia over the last 100 years, accelerating soil erosion and sediment deposition (Kumble, 1990). Since the turn of the century, the human population in the surrounding region has increased 10-fold and approximately 75% of the forest cover has been eliminated. More than 90% of nontidal and tidal wetlands that once covered half of the District's area have been lost. With this urbanization, the Anacostia River and its tributary streams have been altered to the point that floods are ten times more frequent, summer flows are much lower, and stream water temperatures are 5°C to 10°C higher (Kumble, 1990). Hydrological effects, combined with sedimentation and pollutant loading, have degraded aquatic habitats throughout the ecosystem. Stream habitats for migrating fish have been eliminated by the construction of dams, culverts, and other barriers to fish passage. Nonetheless, the District of Columbia continues to support substantial aquatic, wetland, and terrestrial resources that contribute to the ecological integrity of the region and the quality of life for the human population. These resources benefit from the Federal government maintaining 80% of the property bordering the Potomac River, Anacostia River, and Rock Creek drainage basins.

5.2 CONDITION OF ECOLOGICAL RESOURCES

While the current ecological resources of the District of Columbia have greatly changed from early historical conditions, they have improved from the highly degraded conditions in the late 1950s and early 1960s (Bradley, 1959; Leach, 1982). Described below are the extent, status, and trends in aquatic, wetland, and terrestrial resources in the District of Columbia.

5.2.1 Aquatic Resources

The substantial aquatic resources (Figure 5-1) of the District of Columbia comprise several components: (1) 12.5 miles of the Potomac River; (2) the tidal portion of the Anacostia River; (3) 9.3 miles of Rock Creek; and (4) 29 small streams with watersheds within the District of Columbia; and (5) 3 lakes (DCRA, 1994b).

The Potomac and Anacostia are both tidally-influenced large rivers. The Anacostia River is slow-moving and muddy, while the Potomac is faster moving and less turbid. For example, a solid particle can take more than 100 days to move out of these rivers (Bradley, 1959). The relatively stagnant nature of the Anacostia is more likely to concentrate pollutants and is susceptible to low dissolved oxygen levels. As early as 1957, a marked deficiency in oxygen was reported at Kingman Lake and the Navy Yard (Bradley, 1959).

The network of streams in District of Columbia derives from the geology and hydrology of the area (Banta, 1993). The fall line separating hard Paleozoic soils of the Piedmont from the softer soils of the Coastal Plain runs roughly through Rock Creek Park. Although most of the eastern tributaries of Rock Creek have been paved over as part of the combined sewer system, the nearby western tributaries and Rock Creek itself have been protected by park status. Except for the small part of the city that drains into Oxon Run, the eastern portion of District of Columbia (Figure 5-1) is drained by tributaries of the Anacostia that have been drastically altered by urbanization. Some have been eliminated by development and the six southernmost streams now connect to the Anacostia through underground concrete pipes. The few streams with natural streambeds are limited to parklands. Because the upper tributaries of most streams have been covered and converted into storm drains and/or sewers that may or may not drain into the same stream, the hydrological pattern of District of Columbia streams has changed greatly. At present, the District of Columbia contains 16 Piedmont streams (draining 40% of the area) and 13 Coastal Plain streams (draining 60% of the area).

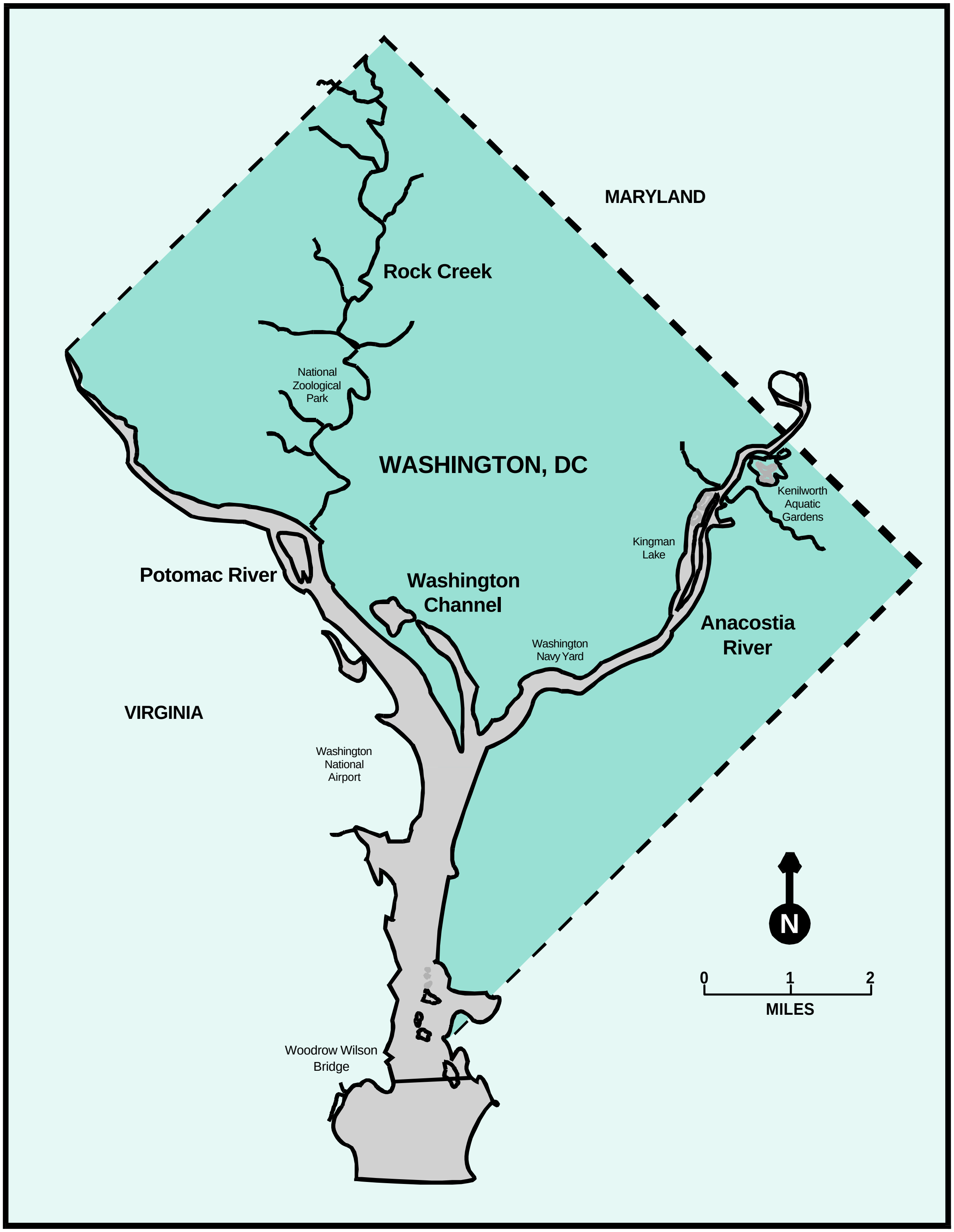

Figure 5-1. Aquatic resources in the District of Columbia.

5.2.1.1 *Support of Aquatic Life Designated Uses*

Similar to every state and territory of the U.S., the District has established water quality standards under the Clean Water Act. Those standards include aquatic life designated uses (i.e., ability of waterbody to support fish and wildlife) for every estuary, river or stream, and lake in the District.

Certain waterbodies in the northwestern part of the District have been designated Special Waters of the District of Columbia (SWDC): Rock Creek (9.5 mi), its west bank (7.5 mi) and east bank tributaries (3.5 mi), and Battery Kemble Creek (also known as Fletcher's Run; 1.2 mi). These special waters have "water quality better than needed for the current use or have scenic or aesthetic importance" and their water quality "shall be maintained at or above the current level" (DCRA, 1994b). All other waterbodies within the District have future designated uses of primary contact, which, with the exception of Hickey Run and Watts Branch, are not currently attained because of high bacteria levels.

Although the District of Columbia anticipates supporting fish and wildlife in all its waterbodies, only a percentage currently perform this function (Figure 5-2). While the majority of estuary areas support the aquatic life use, only one-third of rivers and streams do. Even among the special waters, Battery Kemble Creek does not support its aquatic life use because of possible toxic effects from chlorinated water discharges. The number of waterbodies that support aquatic life (as measured by water quality standards) may be an overestimate if criteria to assess the biological integrity of the District's waters have not yet been developed.

5.2.1.2 *Water and Sediment Quality*

Aquatic resources in all District of Columbia waterbodies have been adversely affected by contamination of their water and sediments. Combined sewer overflows (CSOs) and urban runoff contribute to organic enrichment of waterbodies and create low dissolved oxygen and high biochemical oxygen demand. Toxic chemicals occur at high levels in waterbody sediments, particularly in the tidal Anacostia. The sources of these toxicants are not well understood and are most likely nonpoint in nature.

The Potomac River within the District (12.5 miles of tidal estuary) can be divided into three sections of varying water quality (ICPRB and Abt Associates, Inc., 1994):

- Good water quality from the Maryland border to Key Bridge that supports designated aquatic life and primary contact uses.

- Fair water quality from Key Bridge to Hains Point with stormwater runoff and CSOs via Rock Creek that marginally supports designated uses.

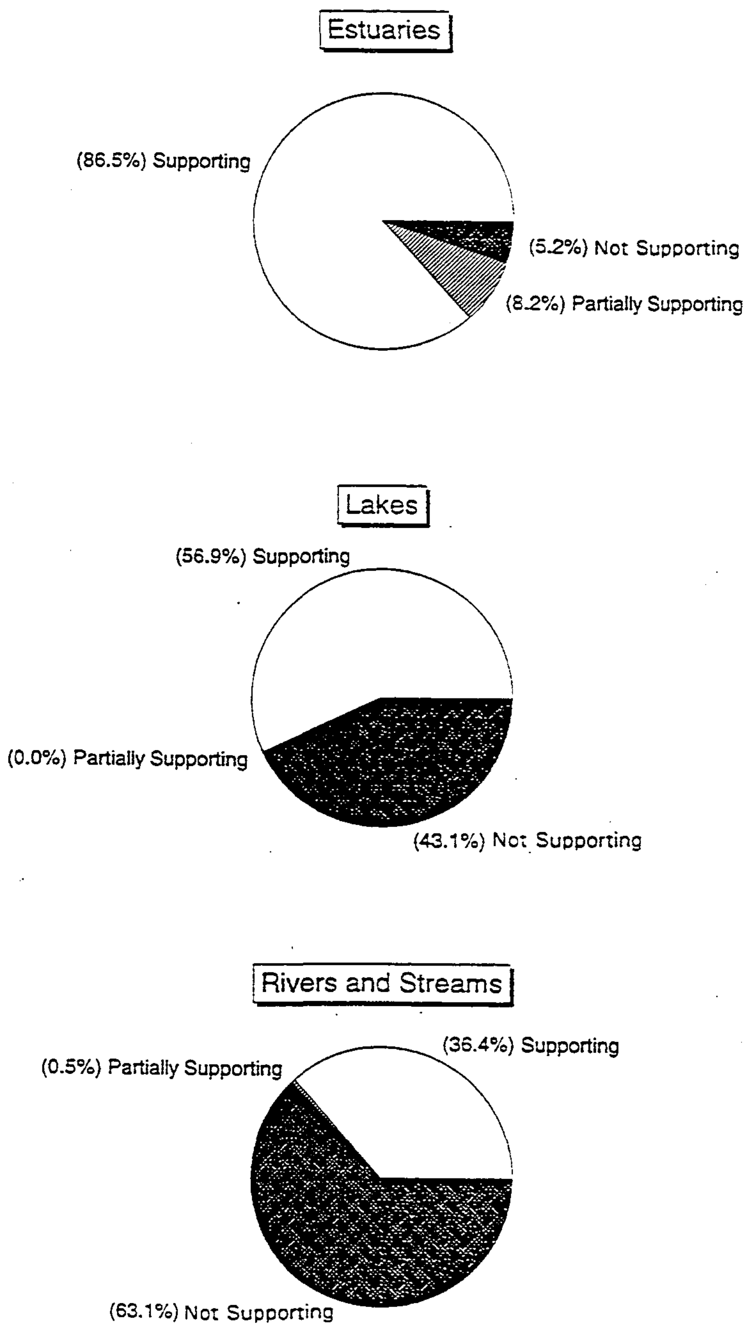

Figure 5-2. District of Columbia waterbodies supporting aquatic life.

- Poor water quality from Hains Point to the Woodrow Wilson Bridge with stormwater runoff and CSOs via the Anacostia River and discharges from Blue Plains wastewater treatment plant that prevent support of the aquatic life use.

Rock Creek (9.3 miles) has water quality problems related to more than 200 outfalls into the stream and other nonpoint source inputs. Organic and chemical pollution are received from upstream and surrounding areas. Metals, pesticides, and polycyclic aromatics have been found above priority pollutant indication levels (Limno-Tech, Inc., 1990).

The tidal Anacostia estuary has some of the poorest water quality recorded in the Chesapeake Bay system because of CSOs and nonpoint source pollution (ICPRB and Abt Associates, Inc., 1994). As a tidal river with a flushing time of 44 days, pollutants transported by channelized tributaries rapidly reach the river and remain there for extended periods. Siltation results from highly erodible soils and development upstream. CSOs and stormwater runoff produce high nutrient concentrations and deplete dissolved oxygen. High sediment oxygen demand results in dissolved oxygen levels below the District's standard approximately 50% of the time (Kumble, 1990). Water clarity is generally poor, ranging from 2 feet to less than 1/2 foot, decreasing productivity.

High concentrations of polychlorinated biphenyls (PCBs) and chlordane led to a fish consumption advisory in 1989 that is still in effect. Recent studies of the tidal freshwater sediments in the District of Columbia area (Velinsky et al., 1994; Wade et al., 1994; Schlekat et al., 1994), found substantial concentrations of trace metals and organic hydrocarbons (e.g., PAHs), PCBs, and DDTs in many locations including near the Washington Navy Yard, at the confluence of Rock Creek and the Potomac River, and in the upper Washington Ship Channel. The sediment was found to be moderately to highly contaminated with trace metals (Pb, Cd, Zn, and possibly Hg) and organics. Concentration gradients between sewer, outfall, and river sediment samples strongly suggest that urban runoff is the major source of these contaminants. The distribution of PCBs suggests input from specific outfalls, while chlordane distribution is indicative of upstream sources (i.e., Northeast and Northwest Branches in Maryland).

The integrated study by Schlekat et al. (1994) demonstrated that the presence of toxic chemicals in the sediments of the Anacostia River have adverse ecological impacts. Analyses of benthic Asiatic clams (*Corbicula* sp.) indicate that these sediment contaminants are bioavailable. Sediment toxicity tests demonstrated significant mortality associated with organic compounds in Anacostia River sediments. Benthic macroinvertebrate community structure analyses exhibited variable agreement with sediment chemistry and sediment toxicity results. When planning restoration and other activities in the area, the possible mobility of these materials (e.g., during storms or dredging) should be considered.

Another study confirmed the presence, since 1987, of elevated concentrations of PCBs and chlordane in fish tissue (Velinsky and Cummins, 1994). Detectable levels of 50 chemicals (out of 129 investigated) were present in the edible portion of certain fish species collected in District waters. Although the effects on the life of fish or their growth were not examined, it is likely that some species or life stages suffer adverse impacts.

This situation is being addressed by the ongoing development of an Anacostia River Toxics Management Action Plan that is looking at specific toxic inputs (Barry Greussner, ICPRB, personal communication, March 14, 1996). Toxic chemical problems in the Anacostia that have been described to date include the following areas of concern (from the Maryland border to the mouth of the river):

- Hickey Run - runoff of oils and grease from garages for taxis and metrobuses;
- Kenilworth Marsh - possible leaching from a capped landfill adjacent to marsh;
- National Arboretum - historical runoff of pesticides from a dump for pesticides;
- Pepco plant and incinerator at Benning Road - possible soil or sediment contaminants;
- Barney Circle connector - lead in soil from original filling of wetlands;
- Washington Gas facility at 11 St. bridge - plume of contaminants into the River;
- CSOs - the NE swirl concentrator near District of Columbia General Hospital and prison, and the O St. pumping station;
- Navy Yard and Southeast Federal Center - contaminants from former weapons manufacturing activities;
- Pepco plant near Fort McNair - PCBs spill; and
- St. Elizabeth's Hospital - toxic materials in an ash disposal site.

5.2.1.3 *Physical Habitat and Submerged Aquatic Vegetation (SAV)*

As a necessary consequence of building the city, many streams and springs have entirely disappeared over the last 200 years (USGS, 1977). Among the natural waters of the District that have disappeared are Smith Springs, Franklin Park Springs, Gibson's Spring, Caffrey's Spring, City Spring, Tiber Creek, St. James Creek, Reedy Branch, and Slash Run. Many other streams survive only in parklands as the lower segments of their historical reaches (e.g., the last miles of Piney Branch and Broad Branch within Rock Creek Park). Other streams have had their physical characteristics drastically changed through channelization, revetment (addition of concrete facing to stabilize stream banks), and other alterations. The more suburban streams have been altered through utility installations, construction of storm drain outfalls, and structural bank stabilization. Urban streams have generally been altered to the point that floodplain access, riparian vegetation, and aquatic habitat are absent (USACE, 1994b).

The physical habitat of the larger streams and rivers has also been altered by human activities. Increased sediment deposition has diminished the width and depth of the Potomac River, Rock Creek, and Anacostia River. Rock Creek instream habitat below the fall line has been scoured by uncontrolled runoff and faster stream flows, eroding the stream bed and depositing silt (ICPRB and Abt Associates, Inc., 1994). Once 1/4-mile wide, the mouth of Rock Creek is now no wider than the rest of the stream. The increase in runoff from developed areas and agriculture has also decimated the submerged aquatic vegetation (SAV) in the tidal waters (Batiuk et al., 1992). Sediment and nutrient loading to these waters, as well as to the Chesapeake Bay in general, contribute to light attenuation by increasing turbidity, total suspended solids, and chlorophyll a. The SAV provides an important food source for waterfowl, and cover and habitat for fish and crustaceans; it also improves water quality by reducing sediment and nutrients, and by producing oxygen (Hurley, 1991).

The Potomac River historically supported dense stands of natural SAV along its entire length (including several exotic plants that became established in the past 70 years), but much was lost by the late 1930s (Orth et al., 1995). The tidal freshwater river was devoid of SAV in 1978 (Carter, 1992); however, in 1982, SAV began returning to the Potomac south of Alexandria and had spread rapidly by 1984. SAV continued to be absent from the Anacostia River until it appeared in 1993 at low levels. The current distribution of SAV in District of Columbia waters is illustrated in Figure 5-3. Improvements in the Blue Plains wastewater treatment plant that reduced loadings of total suspended solids and particulates probably has contributed to the return of SAV to the District of Columbia tidal waters (Hurley, 1991).

5.2.1.3.1 ***Current condition of SAV.*** Field and aerial surveys over the last 3 years show an increase in abundance and diversity of SAV in many parts of the Potomac estuary (Orth et al., 1995). The Upper Potomac has had a dramatic increase in SAV distribution and abundance in the Chesapeake Bay, expanding to 20 percent of the area where it historically occurred (Tier I Chesapeake Bay SAV Distribution Restoration Goal) and 7% of potentially available areas to a depth of 2 m (Tier III Goal).

Within the District of Columbia, a boat survey of the full extent of the Potomac and Anacostia Rivers concluded that the return of SAV is a "very welcome site," but that its abundance is still "fairly low" (DCRA, 1995). The exotic (introduced species) *Hydrilla verticillata* is by far the most abundant species of SAV in District of Columbia waters. Water stargrass, *Heteranthera dubia*, is the next most abundant with wild celery, *Vallisneria americana*, and the exotic eurasian watermilfoil, *Myriophyllum spicatum*, the only other species observed. The distribution of the different SAV species in the District of Columbia appears random, except for a small area of watermilfoil on the Potomac River between Arlington Memorial Bridge and Chain Bridge (Figure 5-3). The SAV continues to be absent above the railroad bridge in the Anacostia River. The recovery of SAV in the District of Columbia waters indicates a stabilizing trend which parallels reductions in nutrient loads (DCRA, 1994b). The dramatic return of SAV primarily reflects the establishment of the pollution tolerant exotic species *Hydrillia* and, consequently, the composition of the SAV community that is regrowing differs greatly from historical conditions. Although the growth of *Hydrilla* and other exotic species does not restore conditions of the historical estuarine ecosystem, the benefits to existing resources (including exotic game fish) are obvious. Recovery of other aspects of the estuarine ecosystem may follow as native SAV species increase their proportional contribution to SAV abundance.

5.2.1.4 *Benthic Macroinvertebrates*

The dramatic changes to the physical habitat and the water chemistry of the rivers and streams in the District of Columbia leave no doubt that the biological integrity of the aquatic resources has been compromised. Fish are an obvious biological resource of concern, but they are usually too temporally and spatially variable to use as an indicator of biological integrity for specific waterbodies. Partially due to their sedentary nature, benthic macroinvertebrates (small organisms living on or in the bottom sediments) have proven to be an effective indicator of water quality condition and a useful measure of biological integrity. The composition of aquatic invertebrate communities is usually summarized in indices that reflect expected compositions for "healthy" waterbodies. Individual species are rarely part of the evaluation, but harvestable and rare invertebrates are of special concern. The freshwater tidal Potomac does not support shellfish of commercial value, but it does include large populations of Asiatic clams (*Corbicula fluminea*) which are not harvested by the public (DCRA, 1994b). Substantial clam populations are absent from the Anacostia River, probably due to the periodic lack of dissolved oxygen (Anacostia Restoration Team, 1991) and the presence of sediment contaminants (Velinsky et al., 1992). Rock Creek contains several rare spring-dependent species of isopods, ostracods, and amphipods (CH2MHill, 1979).

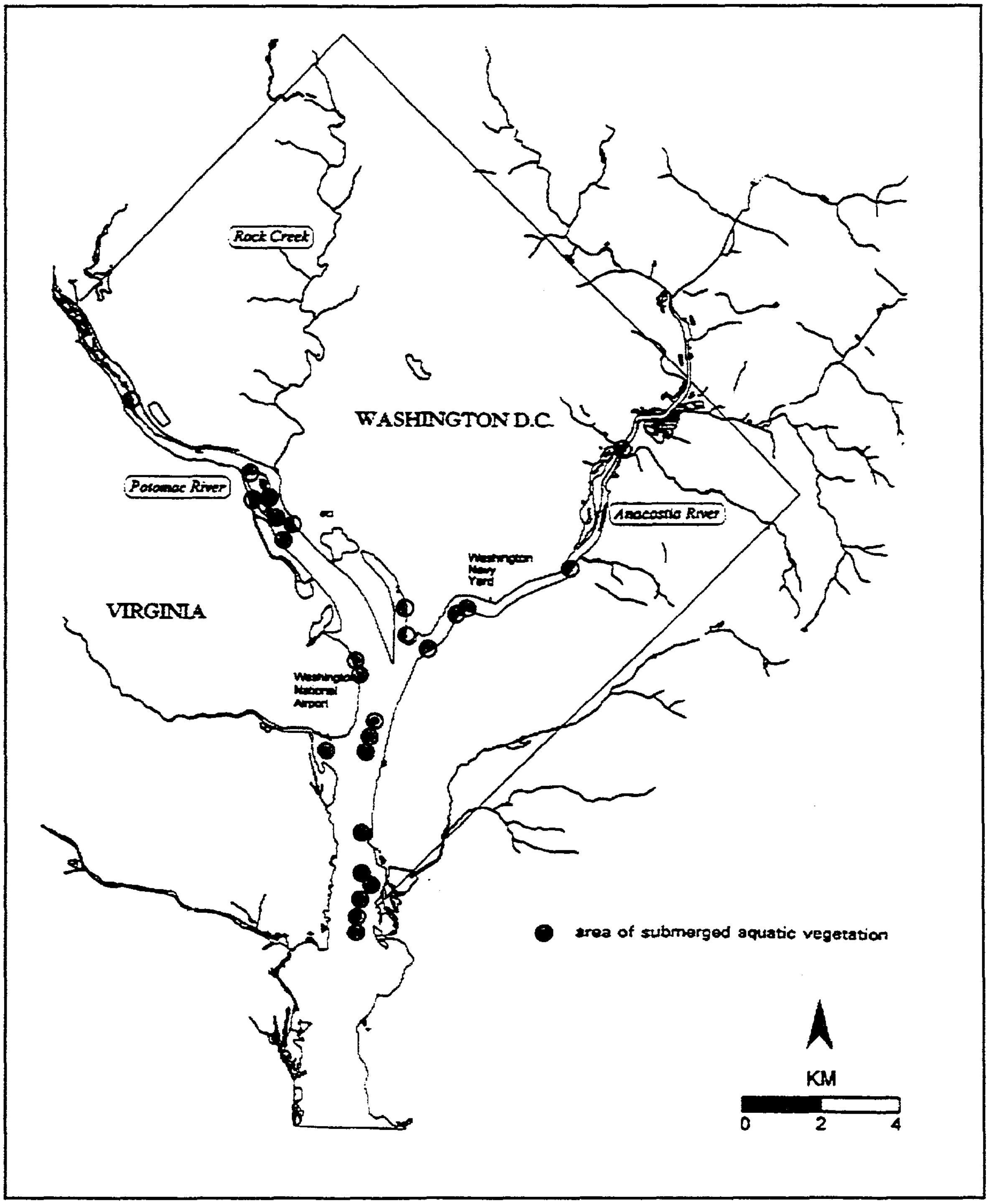

Figure 5-3. Distribution of submerged aquatic vegetation (SAV) in the District of Columbia waters.

5.2.1.4.1 ***Current condition of benthic macroinvertebrate communities.*** Two studies provide systematic coverage of the District of Columbia rivers and streams and the condition of their benthic macroinvertebrate communities. Edmondson (1988) sampled the benthos at 12 river stations on the Potomac and Anacostia Rivers and 12 stream stations within the District including Rock Creek; Banta (1993) sampled 29 smaller streams with watersheds within the District. Together, these surveys present a thorough picture of the biological integrity of flowing water (lotic) systems in District of Columbia. Figure 5-4 illustrates the results of the Edmondson (1988) and Banta (1993) studies. Both studies represent evaluations of the condition of individual sites that may or may not reflect conditions along the entire length of the river or stream, or even within the sampled segment.

The benthic macroinvertebrate community in the Potomac River is fairly homogeneous with the high diversity characteristic of a large freshwater river system (Edmondson, 1988). The communities at individual stations, however, have been adversely affected by consistently high nutrient levels and isolated toxic effects. The Hilsenhoff Biotic Index (HBI) is one of the few indices that provide evaluative condition in the absence of reference sites. Because the HBI focuses on the effects of organic pollution, it is a useful measure of the condition of rivers and streams in District of Columbia. All six Potomac River stations revealed benthic macroinvertebrate communities rated by the HBI as being in poor to fair condition.

By contrast, the benthic macroinvertebrate communities in the Anacostia River were more severely degraded with all six stations rated by the HBI as in poor condition. The community composition was dominated by pollution-tolerant organisms (e.g., oligochaete worms and chironomid dipteran larvae) and was consistent with severe nutrient and toxic stress. Subsequent studies in the Anacostia River (Velinsky et al., 1992; Pinkney et al., 1993) found similar communities of benthic macroinvertebrates. The Anacostia River tributary streams (Oxon Run, Hickey Run, and Watts Branch) had benthic macroinvertebrate communities indicative of habitat degradation from urban runoff, hypertrophic conditions, and toxic contamination. Both HBI values and diversity were low. The HBI values for Rock Creek and Soapstone Creek were also indicative of poor benthic macroinvertebrate communities. As a group, the Potomac River tributary communities were superior in diversity and HBI value, with the highest values in the C&O Canal and the lowest in the Delacarlia.

Although biological indices are very useful indicators of water quality, they often underestimate pollutant loadings in streams where the biota are nearly absent. Sometimes a more useful method of characterizing severely impacted streams is comparing a stream to a stream in more-pristine, less disturbed stream that serves as a "reference" site. All of the smaller streams in the District of Columbia were impaired as a result of the urban land use; many have been

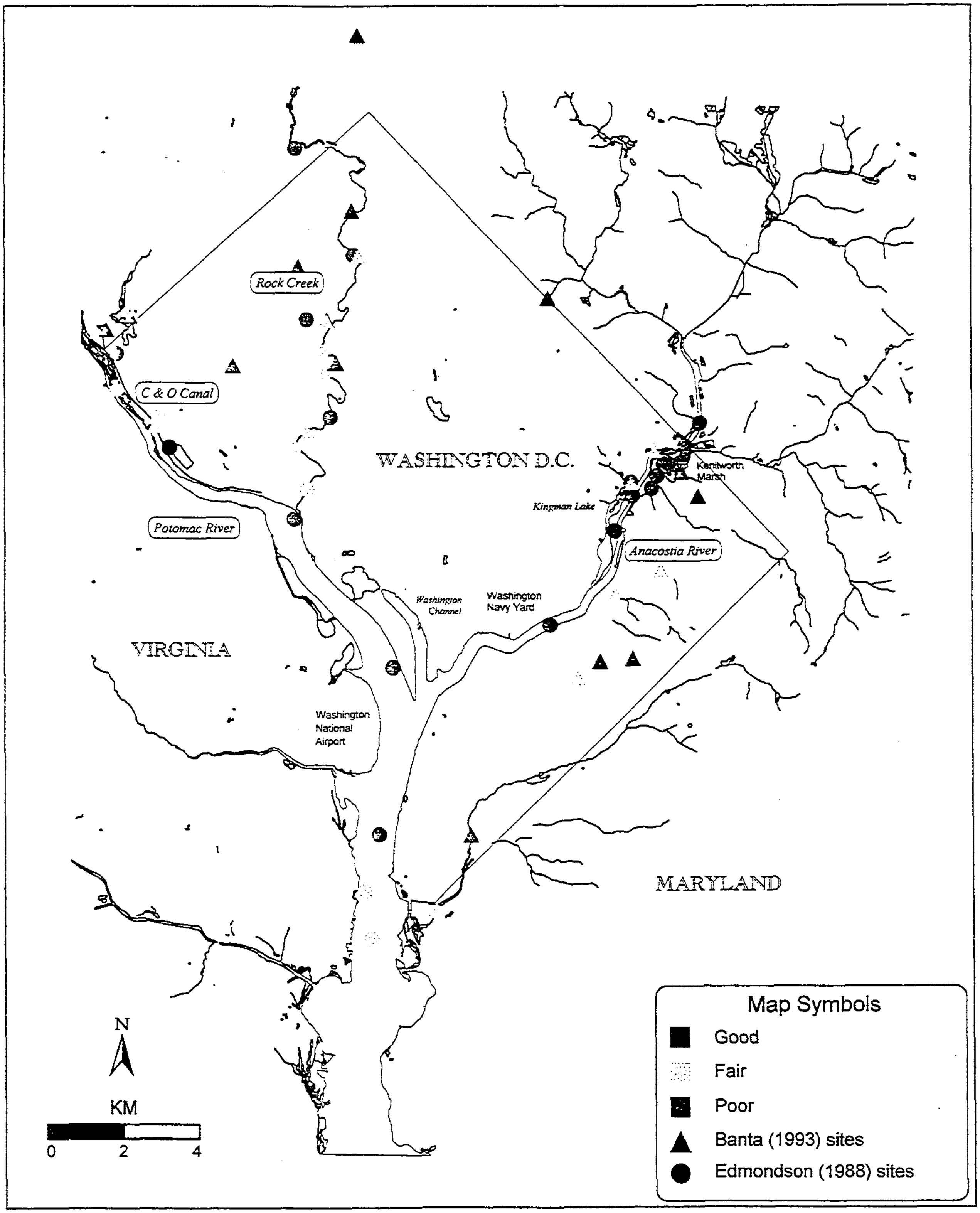

Figure 5-4. Condition of benthic macroinvertebrate communities in District of Columbia waters.

channelized or completely eliminated and replaced by pipes and pavement (Banta, 1993). More than 200 taxa were found in the 29 streams sampled, but very few taxa were found at each site. The benthic macroinvertebrate communities in each stream were dramatically different than those found in reference sites (least disturbed examples from surrounding areas). The impacted communities are characteristic of degradation from physical habitat alteration, organic (primarily sewage) pollution, eutrophication, and toxic chemical pollution.

Each District of Columbia stream was compared to the appropriate Piedmont (Berryville Creek in Montgomery County, Maryland) or Coastal Plain (Cash Creek in Prince George's County, Maryland) reference stream site. None of the 29 streams contained more than 50% of the benthic macroinvertebrate community (as measured by EPA Rapid Bioassessment Protocol III; Plafkin et al. 1989) present in the reference site. According to established EPA evaluation criteria, this translates to severe impairment in 16 streams and moderate impairment in 13 (Figure 5-4). Nearly as many Coastal Plain streams as Piedmont streams were ranked at the same level of impairment. The extreme degree of degradation is evidenced by the presence of less than three taxa at seven sites and the dominance of the pollution-tolerant chironomids at many sites.

Indices of habitat quality (RBP per Plafkin et al., 1989) demonstrated habitat degradation (less than 90% of the habitat quality in the reference streams) in more than two-thirds of both the Piedmont and Coastal Plain streams. The totally channelized Oxon Run possessed only 15% of the habitat quality as the reference stream. However, even when appropriate habitat structure existed, District of Columbia streams exhibited benthic macroinvertebrate communities of depressed quality in comparison to the reference streams. For example, three streams each in the Piedmont and Coastal Plain with more than 90% of the reference habitat quality attained less than a 15% match with the biological community composition.

5.2.1.5 *Fish*

Historically, fish resources in the District of Columbia were the source of a profitable industry and highly valued recreation (USACE, 1994b). Throughout its history, the Potomac River has possessed an exceptionally diverse and productive fish community. For example, the earliest accounts report Native Americans catching 30 sturgeon a night. Populations of American and hickory shad, white and yellow perch, red-breasted sunfish, striped bass, catfish, and river herring were abundant for many years before water quality degraded. As large tidally influenced freshwater rivers, both the Potomac and Anacostia Rivers have the capacity to support many diadromous (fish spending part of their lives in both fresh and salt water) as well as resident species. Even though both rivers have been degraded by the effects of human activities within and beyond the District of Columbia, a wide variety of fish species still occupy these waters.

Table 5-1 lists fish species (arranged by family) that were present at the turn of the century and those that were collected between 1986 and 1994. The decrease in total number of fish species on these lists is only 6.7% (from 60 to 56); however, combined historical and recent records indicate that only 66 species of the 106 fish species known to occur in Potomac and Anacostia Rivers within District of Columbia have been collected since 1987. Several exotic fish species are represented in the diversity numbers including largemouth bass, smallmouth bass, and walleye, and important recreational species of catfish, crappie, and sunfish. These introduced species have been in District of Columbia waters for 80 years; Smith and Bean (1898) reported 10 introduced species and McAtee (1918) reported 14 introduced species.

While most of the species occurring in District of Columbia rivers have persisted, the abundance of nearly all species has dropped, many dramatically. The region supported millions of anadromous (freshwater spawning species with saltwater adult stages) shad and river herring, whose stocks have collapsed or been severely depressed throughout the Mid-Atlantic, including the District of Columbia. The Potomac waters of the District were once a center of striped bass spawning, but the striped bass stocks declined in the 1970s to the point that a moratorium and, subsequently, quotas on harvest were instituted in 1984. While white perch and most other species are also less abundant than they were historically, some are still common. Barriers to passage of migratory species, overexploitation, and poor water quality have all played roles in degrading District of Columbia fisheries. The increase in the abundance of many fish populations in District waters has paralleled reductions in nutrient loads and other water quality improvements over the last 10 years. Although improvements are encouraging, species abundance and diversity are still low compared to historic levels.

As the largest stream in the District of Columbia, Rock Creek has historically supported substantial populations of recreationally important fish species and, through its direct connection to the Potomac River, large numbers of anadromous species. Its National Park status has provided some protection from adverse impacts of urbanization. Nonetheless, the present anadromous fish populations and resident fish communities reflect the harmful effects of polluted runoff (increased summer water temperatures, high concentrations of nutrient, toxic chemicals, suspended sediment, bacteria, and biochemical oxygen demand) and barriers to fish movement (construction of dams, fords, and sewer lines) (Britt et al., 1993). Some species that were historically present in Rock Creek have apparently been extirpated (wiped out) of the watershed (e.g., white perch and trout-perch). Non-native fish species (e.g., largemouth bass, bluegill, and carp) now constitute a significant part of the fish community.

Table 5-1. Comparison of fish species taken from tidal District of Columbia waters at the beginning (1881-1911) and end of the 20th century.

Family	Species	Common Name	Year	
			1881-1911	1989-1994
Petromyzontidae	*Petromyzon marinus*	sea lamprey	X	
Acipenseridae	*Acipenser brevirostrum*	shortnose sturgeon	X	
	A. oxyrhynchus	Atlantic sturgeon	X	
Lepisosteidae	*Lepisosteus osseus*	longnose gar	X	X
	L. platostomus	shortnosed gar		X
Anguillidae	*Anguilla rostrata*	American eel	X	X
Clupeidae	*Alosa aestivalis*	blueback herring	X	X
	A. mediocris	hickory shad	X	X
	A. pseudoharengus	alewife	X	X
	A. sapidissima	American shad	X	X
	Brevoortia tyrannus	Atlantic menhaden	X	X
	Dorosoma cepedianum	gizzard shad	X	X
Engraulidae	*Anchoa mitchilli*	bay anchovy	X	X
Ictaluridae	*Ictalurus catus*	white catfish	X	X
	I. furcatus	blue catfish	X	X
	I. natalus	yellow bullhead	X	X
	I. Nebulosus	brown bullhead	X	X
	I. punctatus	channel catfish	X	X
	Noturus insignis	margined madtom	X	X
Catostomidae	*Carpiodes cyprinus*	quillback	X	X
	Catostomus commersoni	white sucker	X	X
	Erimyzon oblongus	creek chubsucker	X	X
	Hypentelium nigricans	northern hogsucker	X	X
	Moxostoma erythrurum	golden redhorse		X
	M. macrolepidotum	shorthead redhorse	X	X
Cyprinidae	*Carassius auratus*	goldfish	X	X
	Ctenopharyngodon idella	grass carp		X
	Cyprinus carpio	common carp	X	X
	Hybognathus regius	eastern silvery minnow	X	X
	Leuciscus idus	ide	X	
	Luxilus cornutus	common shiner		X
	Nocomis biguttatus	hornyhead chub	X	
	Notemigonus crysoleucas	golden shiner	X	X
	Notropis analostanus	satinfin shiner	X	X
	N. hudsonius	spottail shiner	X	X
	*N. photogenis**	silver shiner	X	
	Notropis procne	swallowtail shiner		X
	N. spilopterus	spotfin shiner		X
	Pimephales notatus	bluntnose minnow	X	X
	Tinca tinca	tench	X	
Umbridae	*Umbra pygmaea*	eastern mudminnow	X	
Esocidae	*Esox niger*	chain pickerel	X	X
Aphredoderidae	*Aphredoderus savanus*	pirate perch	X	

Table 5-1. Comparison of fish species taken from tidal District of Columbia waters at the beginning (1881-1911) and end of the 20th century. (Continued)

Family	Species	Common Name	Year	
			1881-1911	1989-1994
Belonidae	*Strongylura marina*	Atlantic needlefish	X	X
Cyprinodontidae	*Cyprinodon variegatus*	sheepshead minnow	X	
	Fundulus diaphanus	banded killifish	X	X
	F. heteroclitus	mummichog	X	X
Atnerinidae	*Menidia beryllina*	inland silversides	X	X
Percichthyidae	*Morone americana*	white perch	X	X
	M. saxatilus	striped bass	X	X
Centrarchidae	*Ambloplites rupestris*	rock bass		X
	Enneacanthus gloriosus	bluespotted sunfish	X	
	E. obseus	banded sunfish	X	X
	Lepomis auritus	redbreast sunfish	X	X
	L. cyanellus	green sunfish	X	X
	L. gibbosus	pumpkinseed	X	
	L. gulosus	warmouth	X	X
	L. macrochirus	bluegill	X	X
	L. megalotis	longear sunfish		X
	L. microlophus	readear carp		X
	Micropterus dolomieui	smallmouth bass	X	X
	M. salmoides	largemouth bass	X	X
	Pomoxis anularis	white crappie	X	X
	P. nigromaculatus	black crappie	X	
Percidae	*Etheostoma olmstedi*	tessellated darter	X	X
	Perca flavescens	yellow perch	X	X
	Stizostedion vitreum	walleye	X	X
Poeciliidae	*Gambusia holbrooki*	eastern mosquitofish		X
Salmonidae	*Oncorhynchus mykiss*	rainbow trout		X
Sciaenidae	*Leiostomus xanthurus*	spot	X	
Soleidae	*Trinectes maculatus*	hogchoker	X	X
* *N. photogenus* not an Atlantic coastal species -- may be misidentification of *N. rubellus*, (rosyface shiner), a similar species that does occur in the Chesapeake Bay drainage				

Sources: Smith and Bean, 1899.
Bean and Weed, 1911.
Kazyak et al., 1989.
DCRA, 1995.

5.2.1.5.1 ***Current condition of District of Columbia fisheries.*** The current condition of fish resources in the Potomac and Anacostia Rivers within the District of Columbia is improving for many stocks (DCRA,1994b). Several game fish species have shown a significant increase in population size, including largemouth and smallmouth bass, striped bass, crappie, and yellow perch. Cummins (1984) reported that his survey of fish in the Potomac and Anacostia Rivers produced Shannon-Weiner diversity (H') values similar to those found in unpolluted major rivers along the west shore of the Chesapeake Bay, indicating that many areas on these rivers represent healthy habitats for fish. White perch was the most abundant game species along with the forage fishes, gizzard shad, spottailed shiners, and silvery minnows. The diversity of fish collected and the fact that local fisherman have begun to regularly reel in substantial numbers of sportfish from the Potomac River indicate that the District of Columbia fish fauna have rebounded considerably from the period of fish kills in the 1960s (Leach, 1982). Stressed fish with fin erosion are still found, especially in the Anacostia River; however, the high average species diversity found at certain locations in the Anacostia River indicates that even this more degraded river has the potential to support substantial fisheries if water quality is improved.

Surveys from 1985-1988 also show a trend in improving conditions of many stocks, including large numbers of young-of-year (YOY) (Kazyak et al., 1990). In 1990, Kazyak et al. collected 45 fish species representing 15 families and 30 genera from 8 tidewater sites of the District of Columbia using a variety of sampling gear (Figures 5-5 and 5-6). Fish collections included anadromous, catadromous, estuarine, and tidal freshwater taxa of various life stages, and grass carp and hickory shad that had not been taken recently in District of Columbia. The 1994 fisheries survey by DCRA reported a similar diversity totaling 47 species, 13 families, and 30 genera (DCRA, 1994c).

In the Potomac River, 12,000 fish from 40 species were collected with white perch (*Morone americana*) the most abundant and most frequently collected. Pumpkinseed (*Lepomis gibbosus*) also occurred in more that half the samples. In the Anacostia River, 15,000 fish from 25 species were collected; white perch (*Morone americana*) was most frequently collected, but YOY blueback herring (*Alosa aestivalis*) were most abundant. Gizzard shad (*Dorosoma cepedianum*) also occurred in more that half the samples. Less than 1% of all fish collected was piscivores (predatory fish that eat other fish). The occurrence of abnormalities (principally lesions, deformities, and emaciation) was 0.5% for the Potomac and 0.7% for the Anacostia, reaching a high of 1% in the fall for both rivers.

As stated earlier, recreationally important species have declined in abundance throughout the area. The largemouth bass is the only gamefish found in substantial numbers much of year, and its populations have declined as well. Chain pickerel and large striped bass once present in large

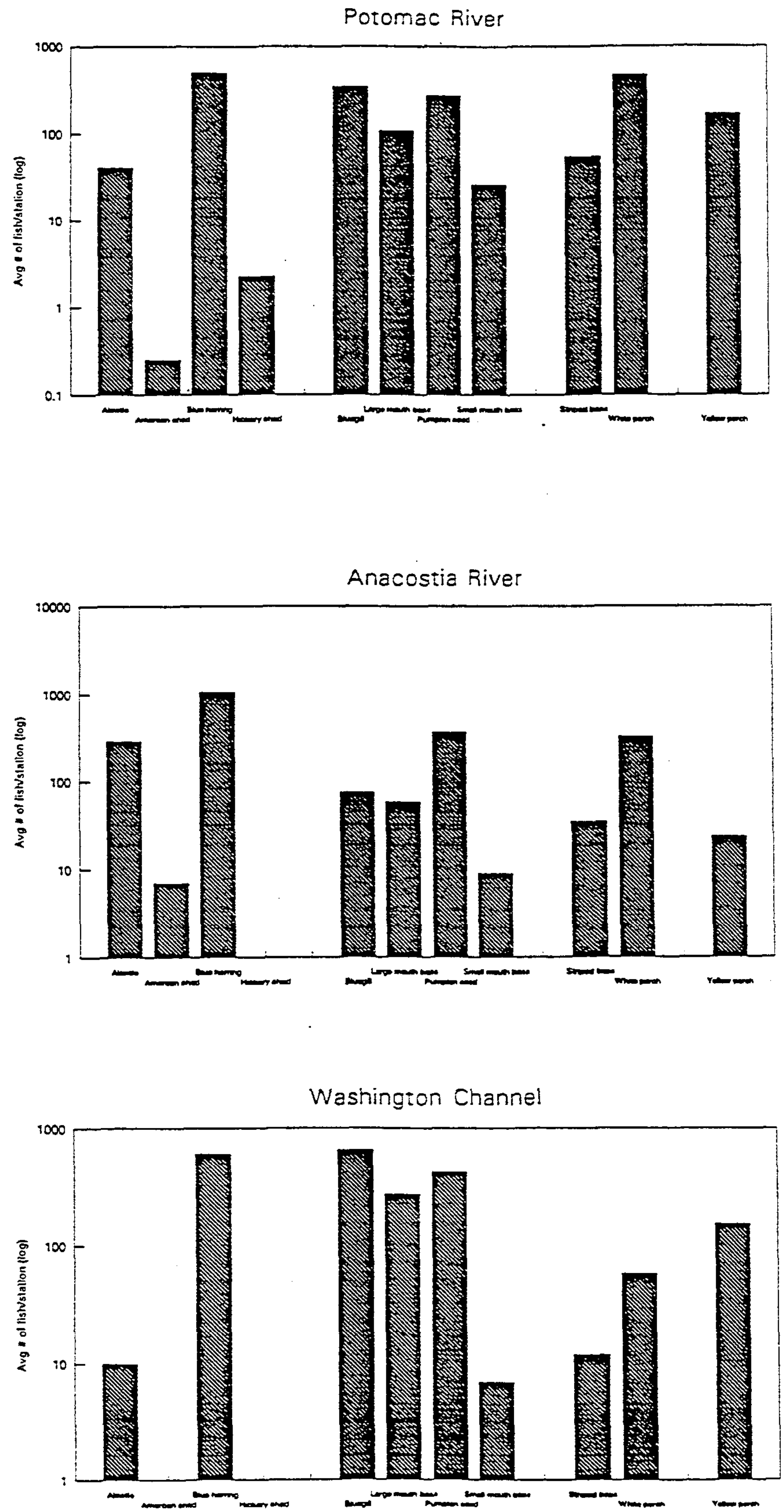

Figure 5-5. Abudance of important fish species in tidal waters of District of Columbia.

Source: DCRA, 1995.

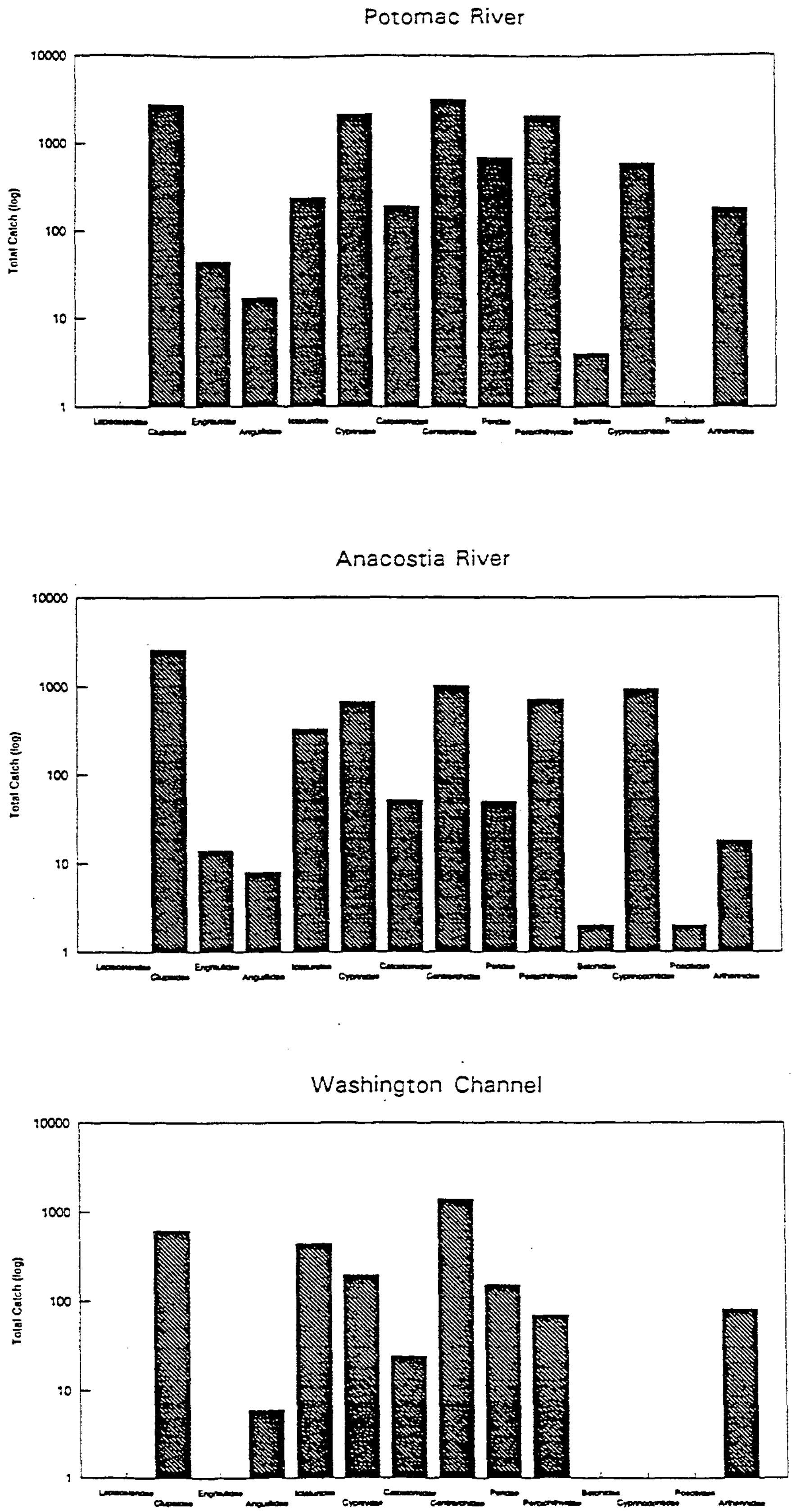

Figure 5-6. Distribution of fish species in tidal waters of District of Columbia.

Source: DCRA, 1995.

numbers in District of Columbia are rare or less commonly encountered. The size of herbivorous/insectivorous panfish has decreased to the point where yellow perch, white perch, and pumpkinseed are rarely of edible size and only brown bullhead is of edible size. This may be a result of the absence of abundant predators to reduce competition among young life stages of fish.

Historically abundant species that now only occur at low levels include the following (Kazyak et al., 1990; DCRA, 1995):

- Striped bass - Potomac waters of District of Columbia were once a center of striped bass spawning, but the important commercial and recreational fishery peaked in the 1960s and declined dramatically in the 1970s causing a moratorium in 1984 and subsequent quotas on harvests. Recent increases in population levels may lead to increased quotas in near future (DCRA, 1994b).

- White perch - Historically, a white perch fishery existed throughout the year in the District of Columbia. The take of white perch in District of Columbia is now limited to 4% of Chesapeake Bay catch, and the growth of individuals is slow.

- River herring - The Maryland catch of river herring was 1-million pounds per year until 1975. Since then, it has declined 10 to 50-fold, and the stocks of alewife and blueback herring are considered severely depressed (ASMFC, 1985 cited in Versar, 1990).

- American shad - Shad stocks collapsed in the 1970s due to overexploitation, migration blockages, and acidification of poorly buffered spawning streams. American shad were again collected in District of Columbia for first time in 1988.

- American eel - There has been a substantial decline from historical abundance level with a particular reduction of young-of-year.

- Pumpkinseed - Historically, District of Columbia had a pumpkinseed fishery in the winter, but individuals are now too small to be pursued by anglers.

- Channel catfish - Channel catfish is an introduced species that has increased in abundance since the 1970s; however, a consumption advisory has been placed on catfish because of elevated levels of PCBs and chlordane.

- Largemouth bass - A substantial sport fishery for the introduced largemouth bass exists in District of Columbia, but high exploitation rates are keeping the size of individual fish down.

Populations of other species in the Potomac and Anacostia Rivers also are generally less abundant than they were historically, although some remain common. The present species abundance and diversity represent a decline from historic levels: this is particularly apparent in many taxa known to be sensitive to environmental degradation (Kazyak et al., 1990).

At present, populations of semi-anadromous yellow perch and white perch in Rock Creek are very reduced or absent (Britt et al., 1993). Declines from historical levels are likely due to overfishing and water quality degradation rather than migration barriers. In contrast, populations of anadromous alewife and blueback herring appear to be healthy. Even though instream impediments to fish movement probably affect these species and prevent them from passing upstream of Pierce Mill dam, schools of hundreds of individuals occur at several locations.

Historical records from Rock Creek are sketchy, but Smith and Bean (1989) noted that certain fish species (e.g., northern hogsucker and fallfish) were already declining at the turn of the century. In 1950, Medford reported that the once abundant brook trout were gone from the watershed and that all large fish and game species were absent. By 1975, Dietemann found only the most pollution-tolerant species within the District of Columbia portion of Rock Creek and attributed declines to land use changes, sewage runoff, and stormwater runoff. In 1993, however, Britt et al. found a three-fold increase in the number of fish species collected per site in Rock Creek. Pollution-sensitive species such as the tessellated darter and cutlips minnow had returned in relatively large numbers. Improvements in water quality through conversion to separate sewers and better construction practices may be responsible.

In contrast to the mainstem, fish communities in Rock Creek tributaries were small or absent. No fish were found in nearly half of the tributaries, and where they did occur, fish density averaged 1.5 fish per 10 miles of stream. These densities are 10-fold less than similar-sized streams in rural south-central Virginia. Episodic water quality problems such as low flows, flooding, or scouring during storm events, and polluted runoff are likely contributing factors (Britt et al., 1993).

5.2.1.5.2 ***Restoration opportunities for District of Columbia fisheries*****.** The continued presence of diverse fish communities in the Potomac River, Anacostia River, and Rock Creek holds the promise for substantial restoration of fish abundance and the re-establishment of significant recreational fisheries. Restoration efforts should focus on three areas:

- Restoring anadromous fish populations;
- Protecting and restoring aquatic habitat; and
- Improving water quality.

The pervasiveness of non-native fishes within the watershed precludes the possibility of returning to historical conditions. In addition, the dramatic changes in the land use of the District of Columbia make it unlikely that species sensitive to high runoff events and sedimentation can become abundant. Species with the potential to increase in abundance as habitat and water quality improve should be the focus of restoration efforts.

Anadromous fish may rapidly access new spawning habitat if dams and other barriers to passage are removed. For example, providing passage on Rock Creek beyond Pierce Mill Dam (SM 4.4) would open an additional 28 miles of Rock Creek and tributaries to migrating spawning anadromous fishes (USACE, 1989). More than 20 partial and final blockages have been identified in the Anacostia watershed above the District line where removal would benefit five anadromous fish species. Habitat restoration efforts range from wetland enhancement in the Anacostia to stormwater controls (to reduce siltation of tributary streams) throughout the watershed.

5.2.1.6 *Endangered and Threatened Aquatic Species*

Under the Federal Endangered Species Act of 1973 the U.S. Fish and Wildlife Service (FWS) has the authority to list as endangered or threatened any distinct species population segments thought to be in danger of being extirpated from an area. The FWS maintains a national list of endangered and threatened species. Species designations used to describe the status of plant and animal species protected under the Endangered Species Act are:

- Endangered - any native species in danger of extinction throughout all of a significant portion of its range; and

- Threatened - any native species likely to become endangered within the foreseeable future.

States, as well as the Federal Government, may designate species as endangered, threatened, rare, etc., within the specific State. The State department of natural resources most often manages these designations. These lists indicate the status of each species within that specific State. The U.S. Department of the Interior's National Park Service (NPS), works with the District's Natural Heritage Program to maintain animal and vascular plant species lists for the District of Columbia (NPS/DCNHP, 1995). These lists are presented in Appendix C of this report.

The degraded condition of the main waterbodies within the District of Columbia makes it very unlikely that they contain rare aquatic species protected by the federal government or the District. Even small streams in protected areas such as Rock Creek Park suffer degradation from abnormally high flows caused by runoff from impervious surfaces. However, uncontaminated ground-water springs do persist in the parks located in the western portion of the District of Columbia. The District's underlying geology includes fractured granite rock that produces ground-water springs from isolated, localized aquifers. Rock Creek Park and several other parks in the western part of the city have protected these springs from development, and as a result, they still harbor a number of rare invertebrates (TNC, 1996).

This "ground-water fauna" consists of crustaceans (amphipods and isopods), aquatic snails, and other organisms that live a mostly subterranean life in water-filled cracks below the surface. The hydrologic isolation of these springs has protected many of them from anthropogenic impacts and provided for the evolution of different species in each. One troglobitic amphipod, *Stygobromus hayei*, is a federally listed endangered species found only from a single spring in Rock Creek Park. Another, *Stygobromus kenki*, is found only in Rock Creek Park and a site in Virginia. *Stygobromus tenuis potomacus* occurs in nearly half the springs in Rock Creek Park. *Stygobromus pizzini*, a Federal candidate species, has not been found in recent surveys and may be extripated (completely eliminated). A watchlist species, Bottimer's spring snail, occurs in three different springs. These unique environments support a high diversity of other invertebrates including a rare ostracod and planarian (CH2MHill, 1979).

5.2.2 Wetland Resources

The District of Columbia was initially built by filling extensive areas of original marshes and swamps along the Potomac and Anacostia Rivers. These wetlands comprised about half the area within the boundaries of the city, totaling more than 9,600 acres of wetlands in 1790 (DCRA, 1994b). Only 284.7 acres of palustrine (marsh), 36.8 acres of lacustrine (lake), and 523.5 acres of riverine wetlands remain in the District today (Guerrero, 1993). This represents a decrease in wetlands area of 91.2% over the last 200 years. As a result, the ecosystem of the District is no longer a large wetland complex, but rather a series of isolated wetlands fringing a highly urbanized area. Many of the remaining wetlands have been degraded and are of poor quality, but some continue to play an important role as a place for waterfowl, wildlife, fish, and shellfish (Guerrero, 1993).

The extensive filling of wetlands is evidenced by the parklands created along the borders of the Potomac River, Washington ship channel, and Anacostia River (Figure 5-7). The replacement of these tidal wetlands with fill material and seawalls in the Potomac estuary to eliminate malaria-carrying mosquitos and in the Anacostia to control flooding and erosion have eliminated the capacity of the natural system to filter sediments and runoff from the city. Some filtering capacity is being returned with the restoration of wetlands along the tidal rivers and tributaries.

In the Anacostia River, less than 100 acres of the original 2,600 acres of emergent tidal wetlands remain. The National Wetlands Inventory maps identify several wetlands on or adjacent

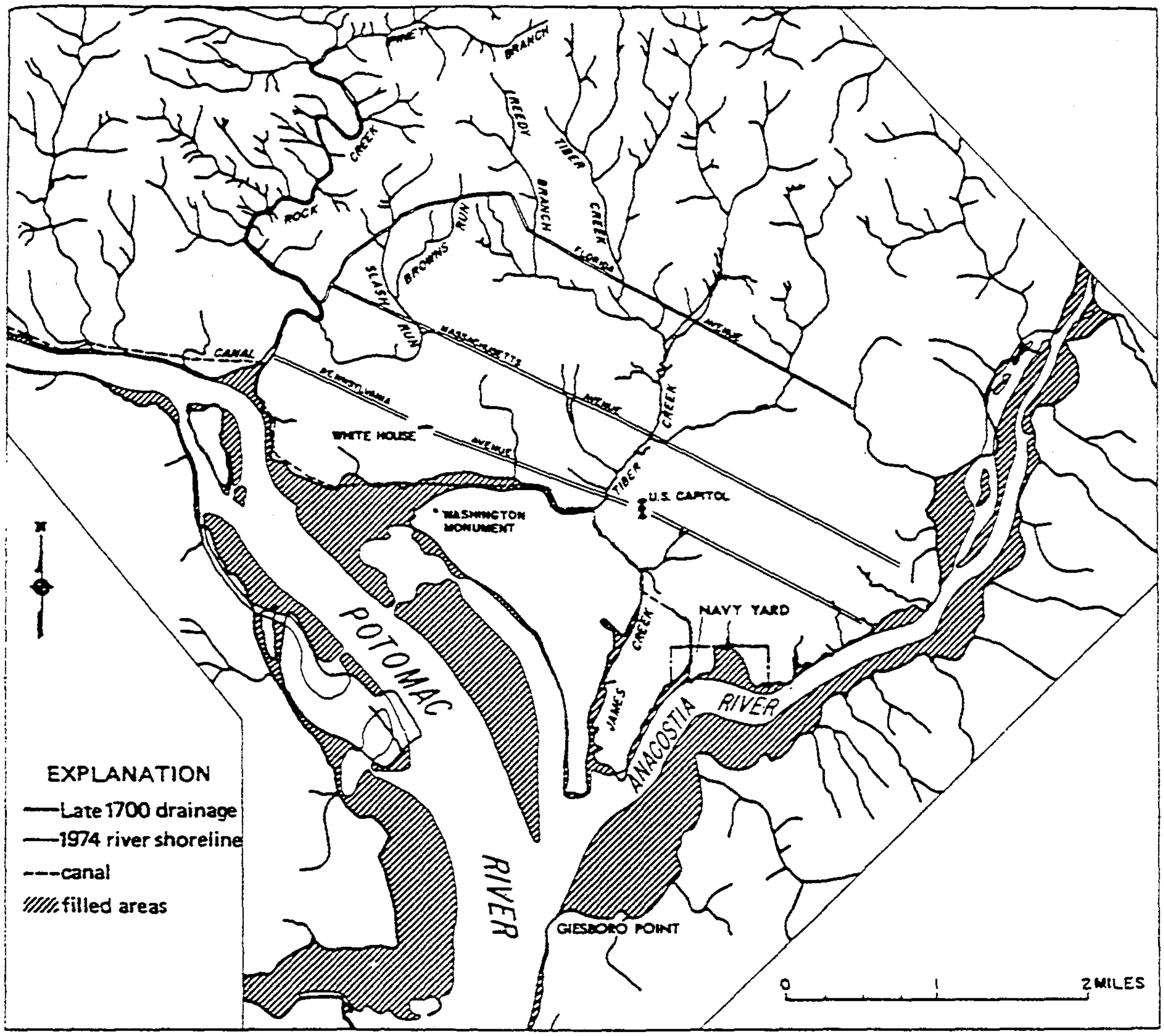

Figure 5-7. Extent of historical wetlands than have been filled in District of Columbia.

Source: Guerrero, 1993.

to the river, primarily between the East Capitol Bridge and Bladensburg (Figure 5-8). The USACE has restored 32 acres of wetlands at Kenilworth Marsh and plans to restore 75 additional acres on the Anacostia River around Kingman Lake (45 acres) and along the banks of the river (30 acres) (USACE, 1994b). The success of these and other restoration efforts depends on addressing the following factors limiting wetland plant regrowth: improper substrate elevation, inadequate sunlight penetration in turbid waters, and abrading or covering plants by garbage and debris (Athanas et al., 1991). Monitoring of Kenilworth Marsh indicates that plant growth was successful and that wildlife use has increased. Preliminary results indicate that contaminants in the dredged sediments used to create the wetlands and invasion by exotic plants in the higher elevations may be problems for current and future wetlands restoration projects (Keith Bowers, Biohabitats Inc., personal communication, February 9, 1996). Kenilworth is one of few natural wetland habitats left for flora and fauna along the Anacostia (O'Conner, 1985) and it, along with the nearby city dump that was closed in 1969, supports a diversity of wildlife.

5.2.3 Terrestrial Resources

The terrestrial environment of the District of Columbia can be divided into four areas bounded by the Potomac River and the border with Maryland: Piedmont west of Rock Creek, Coastal Plain east between Rock Creek and the Anacostia River, Coastal Plain north of the Sunderland escarpment (along Florida Avenue), and Coastal Plain east of the Anacostia River (O'Conner, 1985). Prior to cultivation of much of the area for tobacco farming and extensive construction of the city, this was a forested area that varied in composition from a climax oak-chestnut community in the Piedmont to an oak-pine association in Coastal Plain. Virtually all of the original forest was eliminated by human activities, but native communities have returned in isolated parklands, most notably Rock Creek Park (Figure 5-9). In many places, exotic trees and other plants have substantially altered the vegetation either by intentional plantings or by invasions. For example, invasion by the exotic Japanese honeysuckle has limited the distribution of ferns and herbaceous plants in Rock Creek Park.

Historically, the most distinctive plant community in the District of Columbia region was the magnolia bogs characterized by white sand and gravel soils. This occurred in areas of the Coastal Plain, such as the Bladensburg and Kenilworth communities, and were similar to the unique pine barrens habitats of New Jersey (McAtee, 1918).

5.2.3.1 *Vegetation*

The largest currently existing area of natural terrestrial vegetation in the District of Columbia is Rock Creek Park, a maturing upland community of mixed hardwoods includes oaks, hickories,

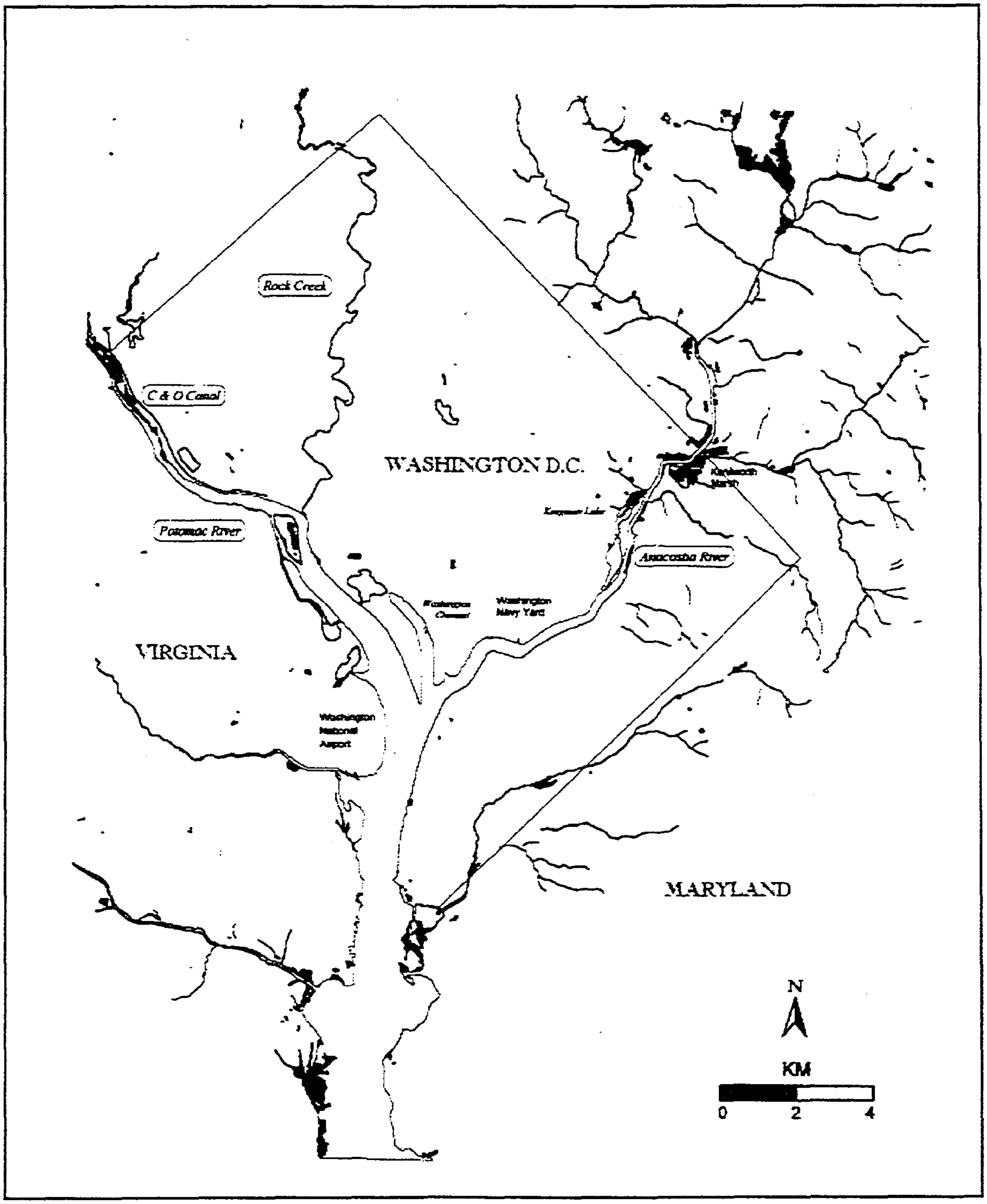

Figure 5-8. Distribution of existing wetlands in the District of Columbia.

Source: Adapted from GIS coveragse for National Wetlands Inventory.

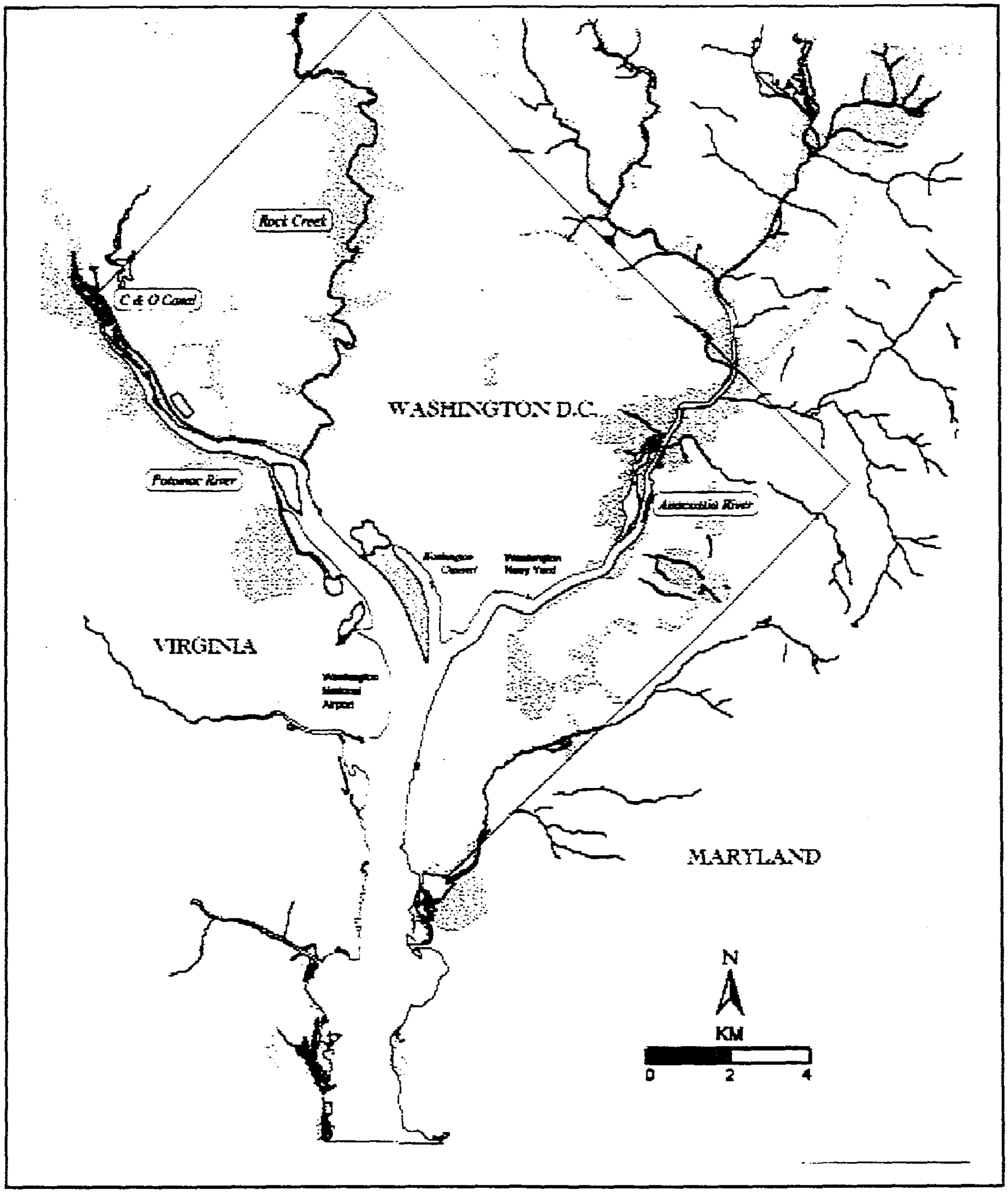

Figure 5-9. Distribution of parks and reserves in the District of Columbia.

Source: Adapted from GIS coveragse for National Wetlands Inventory and
USGS boundary digital line graphs.

tulip poplar, and beech (Jorling, 1969). The understory is dominated by red maple, dogwood, hornbeam, black-gum, mapleleaf virburnum, arrowwood virburnum, and wild grape. Floodplain areas include basswood and American sycamore in the canopy, and box elder, and elderberry in the understory. Mosses are the most abundant non-vascular plant group in the park, but many fungi, lichens, liverworts, hornworts, ferns, horsetails, and clubmosses are also present. Scores of wild flowers occur in the park, many flowering on the floodplain in spring.

Other parks in the western part of the city also have recovering natural vegetation and include important habitats such as ground-water springs supporting rare invertebrates. (See Section 5.2.1.6.) Other parklands in the District of Columbia are generally restricted to fill areas along the rivers, are mostly devoid of trees, and include many exotic species. These areas contribute little to the terrestrial ecosystem of the District. One exception may be the closed city dump that borders Kenilworth Marsh.

Riparian vegetation is especially important to the integrity of the District of Columbia ecosystem because it provides a buffer for aquatic resources and habitat for terrestrial species near water. Contiguous riparian habitats also provide migration corridors for wildlife, a critical factor in urbanized environments. Because Rock Creek Park surrounds the whole length of the stream (and Maryland parks surround most of its length beyond the District), this area is the most important terrestrial resource in the city. Within the District of Columbia, 9.3 miles of the 33-mile creek are surrounded by 2,118 acres of National Park Service land. Rock Creek Park is the largest natural park in an urban setting in the Nation, extending up to 1.25 miles wide (CH2MHill, 1979). The parklands along the Anacostia River do not provide similar benefits but have the potential to do so, especially if riparian restoration is coordinated with wetlands restoration already underway.

5.2.3.2 *Wildlife*

At the time of European settlement, the area now encompassed by the District of Columbia not only "aboundeth with all manner of fish," but also contained "Beuers, Otters, Beares, Martins and Minks" (McAtee, 1918, citing Captain John Smith). Native Americans camped and hunted in the Rock Creek valley for buffalo, elk, beaver, fox, and smaller game animals. The diverse game fauna also included hares, turkeys, pheasants, woodcocks, partridge, snipes, and ducks.

While many of these species have long since disappeared from all or most of the District of Columbia, 32 of the original 44 species of mammals still occur in Rock Creek Park. Once existing bear, bison, bobcat, elk, marten, mink, otter, porcupine, puma, and wolf are gone, but beaver have returned. Opossums, raccoons, and squirrels have increased in abundance, as have the exotic black and Norway rats, house mice, and stray domesticated cats and dogs. These species are tolerant of human activities and benefit from the absence of larger predators and the abundant food source offered by human garbage. Reduction in faunal diversity and dominance by opportunistic species are common characteristics of urbanized areas.

Populations of amphibian and reptile species in Rock Creek Park have declined in abundance and diversity over the last 50 years (Shostack, 1977). Similarly, the 116 species of birds found in the park reflect a change from a predominantly typical forest interior species composition to a combination of species representative of mixed land uses (CH2MHill, 1979).

5.2.3.3 *Endangered, Threatened, and Rare Terrestrial Species*

The Department of the Interior's National Park Service (NPS), along with the District of Columbia Natural Heritage Program, maintain a species lists of animals and vascular plant species reported to be extant (exist currently) or historically present (existing in the past but not existing currently) in the District of Columbia (NPS/DCNHP, 1995). Reported occurrences of species have been collected from reports, scientific collections, and literature, and have been verified by only limited field surveys. Scientists with the NPS's National Capital Region Conservation Data Center report that currently there are no federally-listed endangered animal species in the District of Columbia (Karen Cieminski, NPS/DCNHP, personal communication, April 29, 1996). Federally-listed threatened animal species reported in the District of Columbia include the peregrine falcon (*Falco peregrinus*), black rail (*Laterallus jamaicensis*), and the loggerhead shrike (*Lanius ludovicianus*) (NPS/DCNHP, 1995). There are 23 species of vascular plants listed as rare extant species and more than 200 species of vascular plants listed as historically present in the District of Columbia (Appendix C).

5.3 PLACE IN THE LARGER ECOSYSTEM

The ecological resources of the District of Columbia do not exist in isolation. The District is a part of the Potomac River basin that is itself part of the Chesapeake Bay watershed. Most of the watershed area supporting Rock Creek and the Anacostia River are outside the District's boundaries in Maryland. Regional activities have an important influence on the condition of District resources and the activities within the city affect regional resources including the Chesapeake Bay.

5.3.1 Influence of Regional Activities on Condition of District of Columbia Resources

Water quality problems in the District of Columbia waters can be attributed, in part, to loadings delivered by upstream tributaries outside the city boundaries. In the Anacostia River, problems of low dissolved oxygen, low water clarity, and high bacterial concentrations can not be solved without control of upstream, as well as nearby sources. This connection to the watershed is well recognized and was the basis for the formation of the Anacostia Watershed Restoration

Committee in 1987. The restoration blueprint for the Anacostia targets the largest number of projects and funding (other than CSO abatement) for stormwater retrofit projects. The combined financial contributions for FY 1993 from Federal, State, local, and regional participants was more than $8 million (Wolfe, 1996). Figure 5-10 presents the FY1993 contributions of each participant. Watershed restoration efforts aimed at the entire watershed are the ones most likely to improve impacts on the tidal river (MWCOG, 1994). A similar situation exists in Rock Creek, where most of the inputs to the stream come from upstream tributaries. Nutrient loadings from agricultural lands in Maryland counties upstream and runoff from the increasingly urbanized communities both strongly affect ecological conditions in the District.

The extensive development of the metropolitan region means that even greater anthropogenic effects are felt by District of Columbia resources than would result from the urban area itself. Both District waterways and parklands experience high levels of human activity, especially from the commuting population. A significant example is the high level of atmospheric deposition from regional automobile traffic. The cumulative impact greatly exceeds that of the District population alone.

The condition of migratory fish species populations is an example of the critical importance of linkages outside the city boundaries. The District of Columbia populations of anadromous fish rely on access to the city waters via the Potomac estuary. At the same time, population numbers are limited by the area of spawning habitat in tributary streams above the District Line. Barriers to fish migration in Maryland counties upstream of the tidal Anacostia reduce the reproductive success of anadromous fish such as herring. The Anacostia Restoration Blueprint has identified 33 fish passage projects, all above the District line. Currently, several blockages within Rock Creek Park would have to be overcome before additional blockages in Maryland would impact anadromous fish species in that drainage.

5.3.2 Contribution of District of Columbia to the Regional Ecosystem

The nutrient problem created by upstream and nearby sources does not stay in District waters but continues to flow downstream and contributes to nutrient loadings to the Chesapeake Bay. Research has concluded that control of such loadings is likely the most important step toward restoration of SAV and, ultimately, the living resources of the Bay. In concert with the Chesapeake Bay Agreement to reduce controllable nitrogen and phosphorus to the Bay by 40% below 1985 levels, all jurisdictions are completing plans to meet nutrient reduction goals. The District of Columbia has completed a nutrient reduction strategy that centers on nutrient removal enhancements at the Blue Plains regional wastewater treatment plant (ICPRB and Abt Associates, Inc. 1994). Blue Plains contributes 92% of the District's nitrogen and 25% of its phosphorus; CSOs contribute 4%

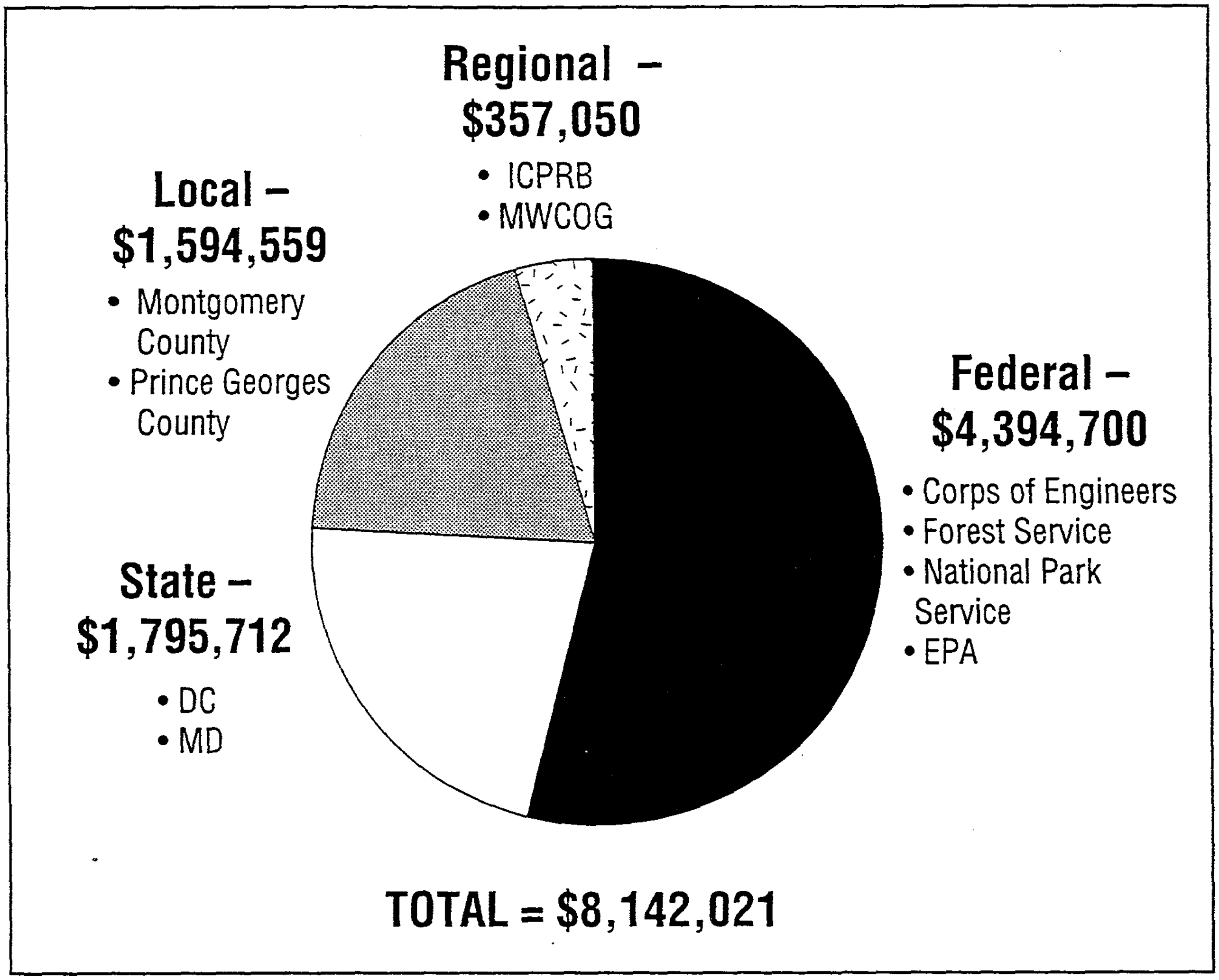

Figure 5-10. Funding for Anacostia restoration effort (FY93 dollars).

Source: Wolfe, J. (USACE), Shell, J. (MWCOG) Personal Communications, 1996 of nitrogen and 68% of phosphorus; and nonpoint sources contribute 4% of nitrogen and 7% of phosphorus. The strategy will exceed the nitrogen reduction target, but the urban nature of the District means that stormwater management and CSO controls may not be able to meet the phosphorus reduction goal. The District may trade nitrogen loading "credits" for phosphorus credits within the larger Potomac River strategy.

In addition to the upgrade of Blue Plains for nitrogen removal, the strategy will re-evaluate the Phase I CSO abatement program and implement the most cost-effective CSO controls in Phase II, and coordinate current programs to reduce nonpoint source pollution (e.g., implement best management practices for stormwater runoff, pollution prevention, and public education). Atmospheric nonpoint sources, such as automobiles, are considered "uncontrollable," but they still constitute a major input to the waters of the District and the Bay.

Although the problems of the District are transported to other places in the region, the status of the area as a corridor for species migrating upstream from the Bay is an important benefit to the regional ecosystem. Specifically, the presence of significant wetlands (i.e., Kenilworth Marsh) and SAV provide important habitat for regional populations of migrating fish and birds. Although water quality problems may hinder fish passage at certain times, no structural blockages for species migrating upstream and downstream occur on the Potomac or Anacostia Rivers. In contrast, Rock Creek does present complete barriers to upstream migration of fish into the Maryland portion of the watershed.

Although the District of Columbia is predominantly urban area in a larger semi-developed metropolitan area, it does contain parkland that can support the activities of wildlife from the surrounding region. The fact that these parks are mostly linear along the riparian zones of Rock Creek and the Anacostia River facilitates the movement of species. The Rock Creek connection is especially valuable because Maryland-National Capitol Parks and Planning lands in Montgomery County provide a nearly unbroken corridor with National Park Service lands in the District. Most of the Anacostia parks are less valuable because they are not protected natural areas but rather reclaimed wetlands in the form of sparsely wooded lawns. The exceptions are Kenilworth Marsh and other wooded riparian areas. Enhancement of the Anacostia natural area corridor has great potential for supporting biodiversity in the larger ecosystem.

The Anacostia Restoration Blueprint has identified 66 riparian reforestation projects aimed at re-establishing forest habitats within 300 feet of the Anacostia and its tributaries. Large-scale reforestation and protection of natural areas ranging from the tidal Anacostia to the 12,800-acre Patuxent Research Refuge near Laurel, Maryland, would constitute the most important wildlife corridor in the increasingly urbanized Washington-Baltimore metropolitan area.

6. CONCLUSIONS, RISK REDUCTION, AND RECOMMENDATIONS

Overall, the environmental health of the District can be considered to be favorable and the city as a whole should be considered a healthy place to live. However, there are still areas which need to be addressed, both from the human health and ecological health perspectives. While DC is not a heavily industrialized city, there are more than 1,000 facilities that release pollution via air emissions, wastewater discharges, hazardous waste generation, and toxic chemical releases. More importantly, nonpoint source pollution from motor vehicles and stormwater runoff are major factors influencing environmental conditions in DC. Motor vehicles are the single largest source of chemicals that form ozone in the DC area. Runoff from stormwater carries many pollutants to DC's surface waters including nitrogen, phosphorus, and heavy metals. This stormwater runoff problem is compounded by combined sewer overflow loadings of pollutants and bacteria into the city's surface waters.

The most apparent human health risks result from drinking water, fish consumption, air, and lead (from paint, soil, and other sources). Each of these potential problems can contribute to risks from exposure; however, different subpopulations may be at risk via different routes of exposure. As a result, it is difficult to assess the relative importance of different routes of exposure. Regardless, there is a need to better communicate the idea of environmental risk to those persons whose health conditions, age, activity patterns, and lifestyles might result in potentially higher risks (e.g., asthmatics from air pollution, children from lead paint or lead in soil, and subsistence fishermen). With respect to reducing risks to human health in DC, conclusions/recommendations are noted below:

Drinking Water

There have been times when "Boil Water" orders have been issued in the District. Is the water safe to drink?

If you hear a "Boil Water" order issued, please comply with it. Boiling water destroys bacterial contaminants.

In general, DC's drinking water is safe to drink. However, certain individuals that have weakened immune systems should take precautions (consult their physician and/or boil water) prior to drinking the tap water. DC's drinking water is sampled and analyzed in a laboratory every day (however, some tests take several days/weeks for results to become available). The DC water supply provides water to more than 1.3 million people, including the President at the White House. However, the water system is old and there is a need to replace some of the aging components. At certain times, the water is reported to be suspect, since it may contain harmful bacteria. This is true of the water supply in many metropolitan areas, since disease-causing germs may enter the water supply at the water plant, or anywhere along the length of the water distribution system. This does not mean that DC residents need to buy bottled water; it means that you need to listen to the occasional reports about the need to boil water. A "Boil Water" alert should be issued when turbidity (cloudiness) rises above the Federal drinking water standards. This step is linked to the Federal laws for Safe Drinking Water. EPA has ordered approximately 300 large metropolitan water systems, including the District, to test for *Cryptosporidium*, a microbial parasite which can cause intestinal illness. This microbe is considered dangerous, even potentially fatal, to persons with weakened immune systems, such as those with AIDS.

A second area of concern for drinking water is also related to high turbidity. In purifying the District's drinking water, chlorine is used to kill bacteria. At certain times of the year, heavier doses of chlorine are necessary to ensure that the water is free of microorganisms. A by-product of chlorination is a group of chemicals known as "trihalomethanes," or THMs. THMs are known or suspected to cause cancer. EPA has set strict guidelines for the maximum level of THMs that may be present in drinking water. In the past, the levels of THMs in District water have occasionally exceeded these standards.

Fish Consumption

Fish in the rivers of the District are known to contain pesticides and other harmful chemicals. Consumption of certain fish, including eels, carp and catfish, may be dangerous to human health. These fish tend to concentrate chemical poisons in their tissues and therefore give a higher dose than other species of fish, such as bass. The District of Columbia has issued a fishing advisory on three types of fish, due to high levels of PCBs and pesticides found in their flesh. These chemicals are believed to cause cancer and other diseases in humans. If you eat catfish, carp or eel caught in the waters of the District, you may be exposed to a higher dose of these chemicals than is considered healthy. It is very important for fishermen, especially subsistence fishermen, to limit their consumption of these particular fish. Also, it should be remembered that cooking fish does not remove all chemical poisons.

CATFISH......CARP.......EEL........

Be aware of the fishing advisory on certain fish. The advisory was put in place to protect human health. Children and elderly people, as well as pregnant women and persons with serious illness, should particularly not eat these fish, caught in DC waters, on a regular basis.

Air Pollution

The air quality in the District is generally good, however, occasional episodes occur where levels of ozone may be high which can affect human health. Air pollution affects different people in different ways. Persons with breathing disorders are the ones we most commonly think of, but there are other persons who should use caution during times of high ozone (usually the summer) or during air quality alerts. In addition, there are thousands of people who are especially sensitive to ozone, even though they may be healthy. MWCOG has identified the following groups as especially susceptible to the effects of air pollution:

- Any of the estimated 210,000 residents of the area who have serious, permanent, or chronic lung disease, such as bronchitis or emphysema.

- Children under the age of 13. There are an estimated 736,400 children in the Washington metropolitan region.

- Anyone with asthma. There are estimated to be 225,700 asthmatics in the Washington metropolitan area, including 53,200 children and 108,500 adults.

- Any of the 336,000 residents over the age of 65.

Air Quality Alerts

During air quality alerts, protect yourself by avoiding heavy exercise outdoors, including jogging and cycling. Persons who are at high risk (asthma, breathing problems, children) should stay indoors as much as possible, preferably in air conditioning. Since the elderly are particularly at risk, check up on older family members and neighbors during air quality alerts.

The air quality index is broadcast on local television weather reports, in newspapers, and on the telephone weather line.

Ozone mapping (similar to Maryland Department of the Environment's program in the Baltimore area) may be an effort that could be initiated in the DC area to improve tracking and communicating higher ozone levels to those individuals that are more susceptible to asthma and other respiratory problems aggravated by ozone.

Indoor Air Pollution

Indoor air pollution is also a serious issue for many residents of the District. Indoor air quality can be made dangerous to human health by a variety of ordinary household items. Sources of indoor air pollution include:

> **Reducing Indoor Air Pollution**
>
> Protect yourself from indoor air pollution. Have your furnace checked periodically to ensure that it is operating correctly. Have your chimney cleaned. Don't store flammable or volatile cleaners or solvents and liquids indoors, where fumes can build up.

- Gas cooking stoves;
- Kerosene heaters;
- Woodstoves and fireplaces;
- Malfunctioning furnaces; and
- Paints, thinners, solvents, gasoline, and household cleaners.

Lead

Children are usually considered to be at most risk from lead poisoning, but lead affects adults as well. It is much easier to prevent lead exposure than to treat it. Untreated, lead can build up to toxic levels, causing a wide range of effects, including brain damage, malnutrition, and high blood pressure. Be aware that there may be lead in the soils where your child plays. Older homes may have lead water pipes or lead-based paint. Lead-based paint in the home poses a threat to both adults and children. Although many people believe that the major route of human exposure is from children ingesting loose paint chips, inhalation and ingestion of paint dust is even more of a threat. Lead-based paint can be sealed by painting over it to eliminate dust. Avoid sanding and chipping lead-based paint. A specially trained and certified contractor may be needed to do major renovation or paint removal operations. Finally, simple hygiene and housekeeping practices can mitigate some of the risk posed by lead-based paint.

> **Lead Exposure**
>
> Protect yourself and your family from lead exposure. If you have children between 3 months and 6 years of age, have them tested every year. Let the water run for a few minutes, especially in the morning, to flush dissolved lead from the pipes. Use cold water for cooking, drinking and making baby formula.

Ecological Health of DC

From an ecological point of view, there are a number of conclusions and recommendations on issues that still to be addressed:

- Fisheries have been greatly reduced from historical levels and will never attain their original abundance; however, the creation of a substantial recreational fishery for several species is possible.

- Other aquatic resources are in fair to poor condition because of degraded water quality and loss of habitat. Rock Creek watershed streams and the main portions of the rivers can probably be elevated to fair to good status in the future. The best remaining streams should be rigorously protected, including institution of stormwater controls. Anacostia River recovery should focus on controlling CSO and nonpoint source problems that result in low dissolved oxygen and sedimentation.

- Wetlands have been lost, and only persist in less than 10%of historical distribution. Although the historical pattern has been replaced by fill, the extent of wetlands can be increased two to three fold along the Anacostia mainstream. Evidence from Kenilworth is that such efforts will enhance the biodiversity of the area.

- Terrestrial resources in the District of Columbia are minimal, but Rock Creek Park provides a significant benefit to the city and to the region. Unique groundwater springs and rare species should be preserved. Revegetation along the Anacostia will improve both the aquatic and terrestrial resources of the District and the region.

- From an aesthetic point, the condition of the Anacostia is poor because of trash, debris and odors. These factors not only reduce the quality of the human experience with the natural environment, but can also adversely affect the ecological resources, by preventing establishment of SAV and by altering the behavior of organisms.

- The degraded condition of the Anacostia River has warranted its placement on the list of the 10 most endangered rivers (American Rivers 1993 and 1994). It has dropped into the 20 to "30 most endangered" list because "it has received increased attention from the Clinton Administration and others, and by an Army Corps of Engineers wetlands restoration project."

- Restoration of the aquatic resources of the District of Columbia will depend on addressing the difficult problem of continuing urbanization of the watershed. To some degree, urban decay contributes to sprawling development, and by revitalizing urban areas, the region can slow its growth and finance projects like runoff control.

- Several notable restoration efforts addressing ecological resources of the District are already underway. Among these efforts are:

  - Vision for Potomac Basin;

  - Blueprint for Anacostia Restoration (1994) and Anacostia Indicators Project (Warner, MWCOG, personal communication);

  - National Park Service restoration of Rock Creek and Kenilworth Marsh; and

  - U.S. Army Corps of Engineers wetlands restoration project.

  Each effort should be coordinated to ensure that individual activities do not conflict and that use of financial resources is maximized. In this way, the vision of desired local and regional ecosystems will come together.

6.1 FUTURE STUDIES: FILLING DATA GAPS

There are number of data gaps which need to be addressed, as we continue to evaluate the environmental health of the District of Columbia. DC is not a new city; its roots go back to the beginning of our history as a country. And yet, it is a new city - some areas of the District are under development even today.

What affects the District environmentally affects all of us who live or work in the city. We have a need to establish an environmental baseline, which will allow scientists to evaluate the conditions which determine our quality of life. We need to see just how well we are doing in our race to recover our fading resources. We need to invest in our future.

- There is a distinct need to conduct a biological inventory of the resources of the District of Columbia. This is well demonstrated by the lack of scientific literature in this area of specialization.

- It is essential to develop a regional perspective, which extends outside the boundaries of the District proper. An evaluation should be made of the dynamics of pollutant migration between surrounding counties and the District.

- A data base should be established to manage existing information on lead levels in human blood so that it is easier to identify lead poisoning cases and possibly tie them to particular sources to help with preventing lead exposure.

- More data are needed on human activity patterns (fishing, swimming/wading) and demographics. In addition, there is a need for data that are adequate to make comparisons of human risks from environmental conditions across subpopulations and geographic areas of the city.

6.2 RECOMMENDATIONS

Although it appears that environmental conditions in DC are generally favorable, specific recommendations are provided to facilitate risk reduction for susceptible subpopulations. In particular, there is a need to better communicate the idea of environmental risk to those persons whose activity patterns and lifestyles may result in potentially higher risks. Risks from fish consumption, air pollution (including indoor air), lead paint, and drinking water need to be communicated to those who may be more susceptible. Improved communication is intended to result in steps that can be taken to reduce the risks for those subpopulations (e.g., reduce fish consumption, reduce activities on days with high ozone levels, boil drinking water). Surveys have revealed that the fish advisories are not effective in reducing consumption of the species. This is especially of concern for subsistance or recreational fishermen who may be consuming the fish species that may pose the highest risks. Also, those at risk from this route of exposure may also be less likely to understand or adhere to posted advisories.

Other recommendations relate to activities that can be undertaken/continued by government agencies to improve environmental conditions with respect to both human health and ecological resources:

- Recognition should be given to the multitude of recommendations provided by groups such as D.C. Area Water COPs to improve the District's drinking water quality.

- Evaluate drinking water quality "at the tap" across the city. There are more than 70 locations where monitoring is conducted. Determine if or how water quality varies across the District.

- Lead testing should be resumed in the District. In addition to drinking water, testing should also include soil in playgrounds and schoolyards, as well as drinking water, pipes, and paint in older homes.

- Reinstate household hazardous waste pickup, or institute central drop-off points where people can dispose of paints, pesticides, and other household hazardous wastes.

- Compare air quality city-wide, from data obtained at the seven ambient air monitoring stations.

- Implement an ozone mapping and communication program (via television news programs) to better warn the population of high ozone levels in particular areas and to suggest decreasing outdoor activities during these periods.

- Continue to upgrade Blue Plains Treatment Plant to reduce inputs of nutrients into the Potomac River.

- Create an infrastructure to coordinate acquisition and management of human health and environmental risk data, to include information gathered by the multitude of groups currently studying these issues. Similar to the existing groups that coordinate ecological monitoring in the DC area (and Chesapeake Bay area), there is a critical need to develop coherent leadership to coordinate studies on human health. This group can integrate all these data and thereby maximize their use and availability, as well as establishing a clear strategy for the future.

- Create a public "grassroots" level of responsibility for preserving and restoring our natural resources. Every person, regardless of age, social status, race, religion, culture or ability, has the opportunity to make a difference in the quality of life that we all share in the District. This city has more parklands than most; more waterfront, more open space, more green areas. It is incumbent upon every person to enhance their own way of life by enhancing the environment of the District. Among the activities that could be implemented include the many recommendations of the 1991 Action Plan by MWCOG for the Anacostia River basin.

- Continue and expand coordination among federal/state/local government agencies and other groups that are working to improve water quality and biological resources in the Anacostia watershed. Controlling nonpoint source pollution and CSO is an important element in this endeavor.